CLAIMS

What is claimed is:

1. A method for making a hydrothermally-stable catalyst suitable for use in synthesis gas conversion to hydrocarbons comprising:

(A) depositing a compound of a catalytic metal selected from Groups 8, 9, and 10 of the Periodic Table on a support material comprising boehmite to form a composite material; and

(B) calcining the composite material to form the catalyst.

2. The method according to claim 1 wherein the support material comprises synthetic boehmite, natural boehmite, pseudo-boehmite, or combinations thereof.

3. The method according to claim 1 wherein the support material comprises boehmite in the form of particles, wherein the particles have a size between about 20 microns and about 200 microns.

4. The method according to claim 1 wherein the support material comprises boehmite in the form of particles, wherein the particles have an average particle size between about 50 microns and about 90 microns.

5. The method according to claim 1 further comprising preheating the support material prior to step (A) at a temperature between about 250 °C and about 350 °C.

6. The method according to claim 1 wherein the support material comprises no anhydrous alumina.

7. The method according to claim 1 wherein the boehmite is substantially non-dispersible boehmite.

8. The method according to claim 1 wherein the boehmite is substantially dispersible boehmite.

9. The method according to claim 1 wherein calcining is done in an oxidizing atmosphere.

10. The method according to claim 1 wherein calcining is done at a temperature sufficient to convert the compound of the catalytic metal to an oxide form of the metal.

11. The method according to claim 1 wherein calcining is performed at a temperature between 200 °C and 900 °C.

12. The method according to claim 1 wherein the catalytic metal comprises at least one metal from Group 8, 9, and 10 of the Periodic Table.

13. The method according to claim 1 wherein the catalytic metal comprises cobalt, iron, nickel, or combinations thereof.

14. The method according to claim 1 wherein the catalyst comprises between 10 wt% and 50 wt% of the catalytic metal.

15. The method according to claim 1 wherein the catalytic metal comprises cobalt.

16. The method according to claim 15 wherein step (A) comprises:

(1) impregnating at least a first portion of the cobalt on the support material to form a first intermediate;

(2) optionally, drying the first intermediate;

(3) calcining the first intermediate to form a first calcined intermediate; and

(4) impregnating the first calcined intermediate with at least a second portion of the cobalt to form said composite material.

17. The method according to claim 16 wherein the calcining in step (B) is performed at a temperature lower than or equal to the temperature used for the calcining in step (3).

18. The method according to claim 16 wherein step (1) is performed in a non-aqueous solvent.

19. The method according to claim 16 wherein the step (4) is performed in an aqueous solvent.

20. The method according to claim 16 wherein step (4) is accomplished to form a second intermediate, and wherein the method further comprises:

(5) optionally, drying the second intermediate;

(6) calcining the second intermediate to form a second calcined intermediate;

(7) impregnating the second calcined intermediate with at least a third portion of the cobalt to form a third intermediate; and

(8) optionally, drying the third intermediate.

21. The method according to claim 20 wherein the calcining step (6) is performed at a temperature equal or lower than the temperature used for the calcining of step (3).

22. The method according to claim 1 wherein step (A) further comprises activating the catalyst in a reducing atmosphere.

23. The method according to claim 1 wherein the method comprises a multi-step incipient wetness impregnation, and wherein step (B) includes at least a first calcination and a last calcination.

24. The method according to claim 23 wherein the last calcination is performed at a temperature lower than that of the first calcination.

25. The method according to claim 1 wherein step (A) further comprises applying a compound of a promoter metal on the support material.

26. The method according to claim 25 wherein the catalytic metal comprises cobalt, and wherein the promoter metal comprises boron, silver, ruthenium, rhenium, palladium, platinum, or combinations thereof.

27. The method according to claim 1 wherein the catalyst is hydrothermally stable in contact with a feed stream at a high temperature in the presence of water.

28. The method according to claim 27 wherein the high temperature is greater than 190 °C.

29. A process for producing hydrocarbons comprising

(A) contacting a catalyst with a feed stream comprising carbon monoxide and hydrogen in a reaction zone, wherein the catalyst is made by a method comprising:

(1) depositing a cobalt compound on a support material comprising boehmite to form a composite material; and

(2) calcining the composite material to form the catalyst; and

(B) converting at least a portion of the feed stream to hydrocarbon products with the catalyst.

30. The process according to claim 29 wherein step (2) occurs at a temperature between about 200 °C and about 900 °C.

31. The process according to claim 29 wherein step (2) occurs at a temperature between about 250°C and about 500 °C.

32. The process according to claim 29 wherein step (2) occurs at a temperature between about 500 °C and about 900 °C.

33. The process according to claim 29 wherein step (2) occurs at a temperature sufficient to convert the deposited cobalt compound to its oxide.

34. The process according to claim 29 wherein the support material comprises no anhydrous alumina.

35. The process according to claim 29 wherein the catalyst is hydrothermally stable.

36. The process according to claim 29 wherein step (1) further comprises depositing a promoter compound on the support material.

37. The process according to claim 36 wherein the promoter metal comprises boron, silver, ruthenium, palladium, platinum, rhenium or combinations thereof.

38. The process according to claim 29 wherein the method comprises a multi-step incipient wetness impregnation in step (1), and wherein step (2) includes at least a first calcination and a last calcination.

39. The process according to claim 38 wherein the last calcination is performed at a temperature lower than that of the first calcination.

40. The process according to claim 29 wherein the method of making the catalyst further comprises activating the catalyst in a reducing atmosphere.

41. The process according to claim 29 wherein the hydrocarbon products comprise hydrocarbons with at least 5 carbon atoms

42. A catalyst with enhanced hydrothermal stability comprising:

a support comprising aluminum;

a catalytic metal comprising iron, cobalt, or combinations thereof; and

a promoter comprising platinum, palladium, ruthenium, rhenium, silver, boron, copper, lithium, sodium, potassium, or any combinations thereof;

wherein the catalyst has a surface area and loses not more than 20% of its surface area when exposed to water vapor; and

wherein the catalyst is made by a method comprising:

(A) contacting a support material comprising boehmite with a catalytic metal-containing compound and a promoter compound to form a composite material; and

(B) calcining the composite material to obtain the catalyst.

43. The process according to claim 42 wherein the catalyst has a pore volume and loses not more than 15% of its pore volume when exposed to the water vapor.

44. The process according to claim 42 wherein the support material comprises no anhydrous alumina.

45. The process according to claim 42 wherein the boehmite is non-dispersible in aqueous solution.

46. The process according to claim 42 wherein the catalytic metal comprises cobalt; and the promoter comprises platinum, palladium, ruthenium, rhenium, silver, boron, or combinations thereof.